they became secondary to DBS.[94] To enhance predictability, the IUSG recommends that the Commission establish a firm sunset date of January 1, 2005 by which all terrestrial incumbents must have vacated the 2 GHz bands or demonstrated compatibility with unconstrained MSS operations in those bands. Consistent with the ET/Microwave policies, BAS licensees (including public safety services) that have not relocated by the Sunset Date should be required to vacate the spectrum without reimbursement on six months' written notice from an MSS licensee.

## IV. THE ET/MICROWAVE POLICIES, WHEN APPLIED TO PRIMARY FS INCUMBENTS, MUST REFLECT THE COMMISSION'S DECISION TO LIMIT RELOCATION TO THOSE INCUMBENTS THAT RECEIVE HARMFUL INTERFERENCE.

### A. Primary Incumbent FS Licensees Should Only Be Relocated When MSS/FS Sharing Is Not Possible.

The IUSG strongly supports the Commission's affirmation of its earlier decision requiring MSS licensees to relocate only those primary FS incumbents in the 2165-2200 MHz band which receive harmful interference from MSS operations.[95] From the beginning of the Emerging Technologies proceeding, it has been Commission policy to encourage spectrum sharing between emerging technologies services and incumbent 2 GHz operations whenever technically feasible.[96] Thus, the Commission correctly concluded that an MSS licensee should

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94 See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8859 (¶ 66) (citing Establishment of a Spectrum Utilization Policy for the Fixed and Mobile Services' Use of Certain Bands Between 947 MHz and 40 GHz, *First Report and Order*, GEN Docket No. 82-334, 54 RR 2d 1001 (1983)).

95 See MO&O, FCC 98-309, slip op. at 13 (¶ 27).

96 See Emerging Technologies First R&O and Third NPRM, 7 FCC Rcd at 6891 (¶ (continued...)

not be required to relocate any primary FS incumbent with which it can successfully share spectrum.

The MSS and FS communities have extensively studied this matter as part of TIA joint working group TR-14.11/TR-34.2/NSMA ("2 GHz Joint Working Group"). The recommendation of that group is expected to be approved soon. The IUSG supports FCC use of this recommendation as the basis for determining MSS/FS interference and coordination eligibility.

### B. The Commission Should Freeze All Applications for New FS Licenses and Modifications Effective upon Release of the MO&O.

As noted previously, the Commission sought comment in its FNPRM on whether it should impose a freeze on new BAS license applications during the negotiation period.[97] And as discussed above, the IUSG believes that such a freeze (effective on the date of the release of the MO&O) is justified on the grounds that all interested parties are plainly on notice that a freeze on new BAS 2 GHz applications could be imposed at any time.[98] Although the Commission has not sought comment on whether to impose a similar freeze on new FS license applications, the reasons justifying a BAS application freeze also support one for the FS. Like BAS incumbents, primary FS incumbents have been on notice of the pending relocation of FS operations for a

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[96](...continued)
29). See also First R&O, 12 FCC Rcd at 7406 (¶ 42).

[97] See FNPRM, 12 FCC Rcd at 7418 (¶ 71).

[98] See supra Section III.C.6.

considerable period of time; in fact, the FS has been on notice since 1992.[99] In addition, by freezing applications for all incumbent licenses and modifications in the 2 GHz bands (both BAS and FS) effective on the date of the release of the MO&O, the Commission will provide MSS licensees with a set limit on the possible number of incumbents to be relocated, which in turn will provide the "stable environment" that the Commission has stressed is necessary to plan and implement new services.[100]

To add further certainty to the number of primary FS incumbents that MSS licensees may have to relocate, all renewals of FS licenses granted after the date of the freeze should be conditioned on secondary status as of January 1, 2000 (the date on which the allocation of 70 MHz to MSS becomes effective). In addition, the Commission should not grant new FS licenses in the 2 GHz bands starting with the date of issuance of the forthcoming Report and Order.

### C. The IUSG Notes That, with Certain Modifications, the ET/Microwave Relocation Policies Can Be Used For Purposes of Negotiating the Relocation of Primary FS Incumbents.

MSS licensees should, as the Commission has proposed, be allowed to relocate primary FS incumbents that receive harmful interference from MSS operations using the general guidelines established in the ET/Microwave proceedings.[101] The IUSG believes these guidelines

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99 See Emerging Technologies First R&O and Third NPRM, 7 FCC Rcd at 6890-91 (¶¶ 22-26).

100 See id. at 6891 (¶ 30).

101 See Third NPRM, FCC 98-309, slip op. at 22 (¶ 49); MO&O, FCC 98-309, slip op at 13 (¶ 27).

will provide a framework for primary FS incumbents to be compensated fairly for any necessary relocation. However, the guidelines as applied to FS operations should be modified, just as they should be modified in the context of BAS, to take into account the unique nature of MSS. Specifically, the Commission should:

- commence the one-year voluntary negotiation period for non-public safety primary FS incumbents from the date 2 GHz MSS applications were first filed (i.e., July 22, 1997);[102]
- establish a mandatory negotiation schedule for non-public safety primary FS incumbents that ends one year after issuance of the forthcoming Report and Order;[103]
- clarify what constitutes good faith negotiations and the penalties for bad faith negotiations;[104] and
- establish a sunset date of January 1, 2005 after which no relocation costs would have to be paid to primary FS incumbents that have not vacated the 2 GHz spectrum.[105]

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102 See supra Section III.C.8.b.

103 See supra Section III.C.8.b. Given the length of time that all incumbent FS licensees have had notice of pending relocation, the IUSG submits that it is not unreasonable to establish the same one-year mandatory negotiation period for public safety incumbents.

104 See supra Section III.C.8.c. By establishing the book value of incumbent licensees' equipment as the sum to be paid by an MSS licensee seeking to replace that equipment, the Commission would eliminate most issues of good faith other than whether or not the correct book value of the equipment has been determined.

105 See supra Section III.C.8.d.

### D. MSS Licensees Should Be Allowed to Select the Lowest Cost Means of Relocating Primary FS Incumbents.

Just as MSS licensees should be allowed to select the lowest cost alternative when meeting the Commission's standards for the relocation of BAS licensees, so too should MSS licensees be permitted to choose the most efficient and economical means of relocating primary FS incumbents. Most critically, the Commission should not require the replacement of FS equipment where existing FS equipment can instead be retuned so as to avoid harmful interference. Without the option of retuning equipment, MSS licensees will be forced to bear the burden of subsidizing a potential windfall to the benefit of primary FS incumbents. Where the relocation of primary FS incumbents rather than the retuning of equipment is unavoidable, the Commission should not require that primary FS incumbents be relocated unnecessarily out of the 2 GHz band. Instead, it should permit MSS licensees to relocate, for an interim period, primary FS incumbents to a new location within the 2 GHz band, so long as the new location meets the Commission's standards. Finally, MSS licensees should only have to pay the current depreciated (i.e., "book") value of the equipment of primary FS licensees, and any necessary associated engineering and construction costs and FCC fees. As noted previously, payments beyond this sum would confer an unfair financial benefit on incumbent licensees.

## V. THE COMMISSION SHOULD ADOPT, WITH MODIFICATIONS APPROPRIATE TO MSS, ITS ET/MICROWAVE RELOCATION REIMBURSEMENT POLICIES, AND REQUIRE THE SHARING OF RELOCATION COSTS AMONG MSS LICENSEES.

Although the Commission briefly addressed, in the FNPRM, the issue of relocation cost sharing among MSS licensees,[106] the Commission does not propose a clear resolution of this matter in the Third NPRM.[107] Rather, the Commission continues to invite comment "on how costs should be apportioned among MSS licensees," and "whether we should require each MSS licensee to bear this financial responsibility in proportion to the amount of spectrum . . . for which it is licensed."[108] Suggesting the use of the Microwave Relocation/Cost-Sharing formula "whereby the first entrant pays relocation expenses and obtains reimbursement rights from subsequent entrants," the Commission also asks "whether . . . systems [that can coexist with BAS] should be exempted from participation in the relocation/retuning of BAS."[109]

The Commission addresses a situation unique to FS in its discussion of FS relocation, noting that "when a new MSS or other licensee relocates a pair of FS links in . . . [the 2165-2200 and 2110-2150 MHz] bands, another new licensee will benefit by having its spectrum in the paired band cleared."[110] In this circumstance, the Commission proposes:

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106 See FNPRM, 12 FCC Rcd at 7418 (¶ 72), 7421 (¶ 80).

107 Nor is the issue addressed in the MO&O.

108 Third NPRM, FCC 98-309, slip op. at 19 ( ¶42).

109 Id.

110 Id. at 23 (¶ 51).

### A. Subsequent MSS Licensees Using the Same Spectrum as Earlier MSS Entrants Should Be Required to Reimburse the Earlier Entrants for Relocation Costs.

As a general matter, the IUSG is in complete agreement with the Commission's proposal that subsequently entering MSS licensees should be required to reimburse earlier licensed entrants which have incurred relocation and other equipment modification or replacement costs to clear 2 GHz spectrum. But, to assure fairness to all MSS licensees and accord with the particular circumstances of 2 GHz MSS, the subsequent licensee should reimburse the initial licensee[115] only to the extent that the subsequent licensee uses some or all of the frequencies cleared by the former.[116] Under the IUSG reimbursement plan, and consistent with the Commission's ET/Microwave policies, there would be no sharing obligation where a subsequently entering MSS licensee utilizes spectrum that was not cleared by an earlier entrant — in other words, where the earlier entrant created no benefit for the later entrant. In such case, the later entrant must pay for whatever relocation is required for its system. Naturally, if the later entrant's system were deployed following the applicable sunset period, it would be subject to no

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[114](...continued)
individual service needs). See id. at 8870 (¶92).

[115] Since there may be more than one "initial licensee" and there may very likely be more than one "subsequent licensee," the use of these terms in the singular in these comments is also intended to encompass the plural.

[116] The development of a 2 GHz MSS band plan need not alter this basic cost reimbursement concept. If, for example, all licensees are authorized to construct across the entire 1990-2025 MHz band (as the IUSG proposes) but are ultimately assigned distinct sub-bands within which to operate, the reimbursement requirement would only apply if a newly licensed MSS operator were assigned to use spectrum that an earlier MSS entrant had cleared.

relocation obligation at all (except with respect to relocation payments made by earlier entrants prior to the end of the sunset period and involving spectrum to be used by the subsequent entrant).

As all of the 2 GHz MSS applicants propose nationwide (and, in most cases, global) service, for purposes of relocation reimbursement there would be no distinction based upon geographic coverage (whereas, in the case of PCS, reimbursement was tied both to designated licensed frequency blocks and geographic areas[117]). And, unlike the situation affecting PCS licensees, in the instant case there are two categories of incumbent licensees subject to relocation — BAS and FS — each using a different segment of the 2 GHz band.[118] The IUSG, however, sees no reason why relocation reimbursement cannot be determined for both categories of service individually. Thus, if an initial licensee arranges for incumbents to relocate in a portion of BAS Channel 1 and needs only to clear a similar amount of spectrum in the downlink band, the initial licensee's reimbursement entitlement would be separate and distinct for each subsequent licensee that uses either the uplink or downlink sub-bands cleared by the early entrant. This is consistent

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117 See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8861 (¶ 69) (cost-sharing proposed only for PCS licensees that relocate microwave incumbents' links *outside* their license areas since later entrant benefits from clearing of the spectrum in its area).

118 Although the text of the Commission's proposal does not explicitly encompass any reimbursement obligation geared specifically to the use of the FS downlink bands and the cost of relocation of such facilities, this may simply be due to the fact that the proposal was made in the section of the Third NPRM dealing with BAS relocation. The IUSG assumes that any and all such costs would be included in the cost-sharing formula, and that reimbursement obligations for relocation of primary FS incumbents would be determined in a similar fashion.

with the Commission's approach in the PCS context, where it was determined that subsequent entrants would be required to assume reimbursement obligations only when they have benefitted from the spectrum-clearing efforts of another party.[119]

If, for example, MSS System A is conditionally authorized to operate across the entire uplink band as an early entrant but only needs to use six MHz of spectrum early in its system's life, it would, as the initial licensee, arrange to relocate incumbent BAS licensees[120] from a six MHz sub-band. If no subsequent 2 GHz MSS system uses that part of the uplink band, System A would bear the entire responsibility for the described relocation. Any later-entering system using different sub-bands would be required to pay for its own relocation costs for the spectrum it occupies.[121] If numerous MSS systems subsequently begin service and one or all are required to use part of the initial sub-band cleared by System A, each would be obligated for its allocable

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119 See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8862 (¶ 71).

120 In addition, of course, primary FS incumbents might have to be relocated to the extent they receive harmful interference from the initial MSS licensee. In such case, any reimbursement obligation "share" would be determined by the same procedure described herein.

121 Only if the first entrant were to have relocated BAS incumbents out of the band that it plans to use and into bands assigned to another MSS licensee, would System A possibly share in any further relocation burden of the second entrant.

share of reimbursement costs as determined by the Commission's cost-sharing formula[122] (as modified by the suggestions below).

In the case where an MSS system is able to share with another (as in the case of systems with CDMA access) and both are authorized a common spectrum assignment, each would bear an equal share of the relocation costs even though one may, in rendering service, utilize a smaller portion of the capacity. Otherwise, the IUSG submits, the uncertainties of future spectrum use due to demand fluctuations and system modifications would make the relocation cost obligation impossible to quantify. If two subsequently entering, sharing-capable MSS systems are assigned spectrum used by an earlier entrant that has incurred relocation costs, the newly entering systems would each be responsible for one-half of the relocation reimbursement obligation in accordance with the cost-sharing formula.[123]

In this connection, consistent with the Commission's ET/Microwave goals and within certain limits outlined below, all subsequent licensees should be bound by the agreements reached by the negotiating parties regardless of the nature of the relocation arrangements with

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122 See id. app. A at 8877-8900. As explained in Appendix A of the Microwave Relocation/Cost-Sharing First R&O and FNPRM, where there is partial spectrum overlap, a pro rata portion of relocation costs would be reimbursable. See id. app. A at 8884-85 (¶¶ 16-17).

123 Similarly, if, as a result of a Commission-adopted band plan or intersystem coordination, an early entrant is forced to relocate entirely out of spectrum it has cleared, its full relocation costs would be paid by the newly entering MSS licensees. The costs to be reimbursed would include all documented costs, including cost of capital, in relocating the incumbents and no time-driven "depreciation" factor would be included.

incumbent BAS or FS licensees that were originally made by the early entrant(s). To do otherwise would undercut the very process the Commission has determined to establish and would unfairly depart from the ET/Microwave policies previously followed.

### B. The Cost-Sharing Obligations of MSS Licensees Should Not Be Premised Upon a Proportionality Scheme.

The Commission has also suggested that each MSS licensee bear relocation responsibility "in proportion to the amount of spectrum in the 1990-2025 MHz band for which it is *licensed*."[124] The IUSG cannot support this proposal if, as it appears, the Commission intends that the relocation obligation will be unrelated to the relocation costs of incumbents in spectrum which the MSS licensee actually uses. Requiring any MSS licensee to incur relocation obligations for spectrum it does not use is the very antithesis of the Commission's current ET/Microwave policies. Nowhere in the record of the development of those policies has the IUSG found any suggestion that a PCS licensee would be required to pay for relocation costs incurred to relocate incumbent licensees outside its licensed spectrum block. Thus, an A block PCS licensee is not obligated to pay a C block licensee for any portion of the latter's relocation costs.

The Commission's proposed relocation cost-sharing plan also would have discriminatory and punitive effects on early entrants to the 2 GHz MSS marketplace. For example, an early entrant would be required under that plan to assume relocation obligations to clear spectrum that it plans to use, but would receive no reimbursement for its expenditures until after other MSS licensees enter the marketplace — a delay that is likely to be several years in length. The

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[124] Third NPRM, FCC 98-309, slip op. at 19 (¶ 42) (emphasis added).

Commission gives no indication that early entrants would be entitled to recover the cost of capital related to those expenditures from subsequent entrants. The subsequent relocators, however, would be entitled to obtain from earlier relocators reimbursement for all relocation expenditures immediately. Thus, in real terms, early entrants would suffer a severe financial penalty from being the first to market vis-a-vis their competition. The IUSG submits that the Commission's policies should be designed to promote and reward, not discourage and punish, innovation and initiative on the part of Commission licensees.

The Commission's "proportionality" proposal may well be premised on the notion that some spectrum blocks will be more costly to clear than others. This supposition, however, is unsupported by any record evidence. Furthermore, it contradicts the approach taken by the Commission with regard to PCS, in which six different licensees (A, B, C, D, E and F blocks) were each given defined spectrum to clear.[125] The Commission has every reason to apply the approach that it adopted for PCS to 2 GHz MSS, and no reason to do otherwise.

### C. The IUSG Supports the Commission's Suggestion for a Non-Profit Clearinghouse to Administer the Reimbursement Program, But the Cost-Sharing Formula Requires Modification to Satisfy the Unique Needs of 2 GHz MSS.

In addition to the question of how relocation obligations should be shared among MSS licensees, the Commission must resolve the equally significant issue of how the payment of all required reimbursements is to be administered. The Commission proposes that its

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125 See Microwave Relocation/Cost-Sharing Second R&O, 12 FCC Rcd at 2706 (¶ 1), 2706 n.3; Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8845 (¶ 37), 8862 (¶ 71).

ET/Microwave policies and rules be followed in this regard, including the use of a cost-sharing formula similar to the formula developed in conjunction with those rules.[126] While the use of the specific cost-sharing formula developed in the Microwave Relocation/Cost-Sharing proceeding may not be appropriate in the context of 2 GHz MSS, the IUSG does support the use of a neutral, non-profit clearinghouse to administer the cost-sharing plan and determine the amount that subsequent MSS licensees must pay to an initial relocator based on principles determined by the Commission in this proceeding.

### 1. A Neutral Non-Profit Clearinghouse Should Be Used For 2 GHz MSS.

The IUSG supports the use of a neutral, non-profit clearinghouse to administer the cost relocation reimbursement program for 2 GHz MSS similar to that used for PCS.[127] Given the limited number of potential MSS licensees (as compared to the number of PCS licensees), however, the IUSG suggests that only one entity be designated as the 2 GHz MSS clearinghouse.

### 2. The Unique Characteristics of 2 GHz MSS Require Modifications to the Microwave Relocation Cost-Sharing Process and Formula.

In overseeing the administration of the reimbursement of relocation expenses incurred by PCS licensees, the Commission established the following procedures:[128]

- an initial PCS licensee obtains reimbursement rights for a particular microwave link on the date that it signs a relocation agreement with the incumbent licensee;

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126 See Third NPRM, FCC 98-309, slip op. at 19 (¶42).

127 See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8861 (¶ 69), 8862 (¶ 72).

128 See id. at 8862-63 (¶¶ 72-76).

- within ten business days of the date the agreement is signed, the PCS licensee submits documentation of the agreement to the Commission-designated clearinghouse;

- prior to commencing commercial operations, each subsequent PCS licensee forwards a prior coordination notification ("PCN") to all earlier entering licensees in the same geographic area (a copy of which PCN is forwarded to the clearinghouse);

- the clearinghouse then determines, by application of an objective test and on a link-by-link basis, whether the newly entering PCS licensee harmfully interferes with the subject incumbent licensee's facilities;

- if it determines that harmful interference exists, the clearinghouse then notifies the subsequent PCS licensee of this fact and the amount due the earlier entrant pursuant to the Commission's cost-sharing formula;

- once it receives written notification from the clearinghouse of its reimbursement obligation, the new PCS licensee must remit the full amount owed within 30 days; and

- all relocation cost-sharing obligations sunset ten years after the date that voluntary negotiations commenced for the PCS A and B blocks.

The entire foregoing procedural mechanism is based on the notion that only subsequently entering licensees that will benefit from the spectrum-clearing efforts of another party are required to assume reimbursement obligations.[129] The IUSG agrees with this concept and the essential procedural steps the Commission outlined to embody it. The IUSG urges that a similar approach be adopted for 2 GHz MSS, although the approach should be modified to take into account the unique aspects of satellite communications and the phased transition which will occur as new MSS develops in the 2 GHz bands.

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[129] See id. at 8862 (¶ 71).

As described in other sections of these comments, the development of 2 GHz MSS will not occur, in most respects, in a manner identical to that of PCS (for which service the Commission's cost-sharing formula was developed). Instead, new mobile satellite services will be nationwide rather than geographically distinct; spectrum may not be assigned in defined blocks for all licensees, though it may be for some; the incumbents to be relocated will comprise two categories of services rather than only one service; harmful interference may not arise for some incumbent licensees for many years, if at all; and, given the large up-front capital investment required for satellite systems and the long lead time necessary for their construction, numerous new MSS systems will be deployed over an extended period of many years rather than a period of many months as was generally the case with PCS.

The Commission's existing cost-sharing process for PCS does not adequately address these differences and, as a consequence, and in order to satisfy the public interest objectives of relocation reimbursement,[130] the IUSG urges that the reimbursement process be modified in the following respects (key changes to the PCS reimbursement procedures are italicized):

- although an initial MSS licensee would obtain reimbursement rights for relocating (either in-band or out-of-band) existing BAS and/or FS incumbents on the date a relocation agreement is signed, *in the case of involuntary relocation, the date for acquisition of reimbursement rights would arise on the date that the initial MSS licensee submits relocation compensation to the incumbent licensee* following written notification of the involuntary relocation;

- documentation of either a signed relocation agreement or, *in the case of involuntary relocation, evidence of payment*, would be submitted to the Commission-designated clearinghouse within ten business days;

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[130] See supra n.113.

- rather than forwarding a PCN before commencing commercial operations, *all subsequent MSS licensees would forward their respective PCNs within 30 days of receiving license authorization from the Commission, or meeting system milestones which the Commission designates as triggering intersystem coordination rights, but such PCNs would only be sent to earlier MSS entrants operating on the same uplink and/or downlink frequencies as the new entrant* (as well as to the clearinghouse);

- *the Commission would use the forthcoming 2 GHz Joint Working Group recommendation for MSS/FS issues. (The IUSG supports the use of this recommendation as the basis for facilitating MSS/FS frequency coordination.) In the case of BAS, a new measure based on relative geometry and statistics of MSS terminal use would need to be developed*;[131]

- once it is determined that harmful interference results to either the affected BAS or FS facility, the clearinghouse would notify the later entering MSS licensee of this fact and the amount due the initial entrant under the Commission's cost sharing formula *as revised for 2 GHz MSS* (see discussion below);

- as in the case of PCS, the new MSS entrant would reimburse earlier entrants within 30 days of receiving the clearinghouse notification; and

- all new relocation cost-sharing obligations would *sunset within ten years after the date that the mandatory negotiation period ended.*

Although this recommended process for MSS relocation reimbursement is very similar to the PCS model, certain elements of the cost-sharing formula itself require modification due primarily to the fact that competitive 2 GHz satellite services will be deployed over a period of many years and on a nationwide basis.

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[131] It is not expected that MSS user terminals will represent a significant interference concern into BAS links. To the extent that BAS transmissions may cause interference to the MSS satellite receiver, it is left to the MSS operator to determine whether such interference is harmful.

*First*, the IUSG believes there is ample justification for ensuring that the early entrant — whose large capital expenditures cleared the way for MSS use of the band — is also compensated for the cost of capital involved in such relocation. Although it appears that the Commission did not address the issue of cost of capital in its ET/Microwave rulings,[132] the IUSG is aware of no valid economic position that would argue against reimbursing the initial relocator for the cost of carrying the expenditure for the benefit of subsequent MSS entrants.[133] Moreover, the use of the so-called "depreciation" factor, whereby the reimbursement obligation of subsequently entering licensees is reduced over time,[134] exacts a double penalty against the initial entrant when such entrant should be rewarded for taking the risk of bringing new services to the public. Thus, the new entrant is required to clear the band it uses on its own, and later entrants that occupy the same frequencies can take occupancy without paying the initial entrant the cost of money needed to fund the relocation; then, the later entrant gets a substantially reduced obligation to boot.[135]

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132 The Commission only addressed the issue of payment of interest in the instance when a PCS licensee is allowed to pay for its license in installment payments. See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd app. A at 8898 (¶ 43).

133 No such interest would be due under the IUSG proposal, of course, if the subsequent MSS entrant does not utilize the same frequency spectrum as the initial entrant.

134 See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8862 (¶ 74), app. A at 8878 (¶ 3). The inclusion of the "depreciation" factor was premised on the asserted "first to market" advantage, which the Commission found in its earlier ET/Microwave decisions to justify the factor's use.

135 In this regard, it is noteworthy that the Commission proposes to eliminate the "depreciation" factor in connection with the relocation of FS paired links. See (continued...)

The application of the "depreciation" factor to the relocation of 2 GHz incumbents will disserve the public interest, as it will unfairly discriminate among licensed MSS licensees and, in addition, will certainly slow the pace at which the initial entrant(s) begin to offer service.[136]

*Second*, the Microwave Relocation/Cost-Sharing procedures include a mechanism for the payment of relocation reimbursement obligations over time for those entities eligible for installment payments under the Commission's auction rules.[137] Given the exceedingly large capital requirements of a regional or global satellite system and the fact that such systems are almost always constructed and/or financed by large companies with substantial capital resources, there is no justification for extending such favored treatment to entities applying for 2 GHz MSS systems. The IUSG accordingly urges that the Commission modify its cost-sharing formula to omit installment payments for relocation reimbursement.

*Third*, if, notwithstanding the great difficulties and costs inherent in its proposal to force a simultaneous BAS relocation nationwide (see supra Section III.C.2), the Commission were to

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[135](...continued)
Third NPRM, FCC 98-309, slip op. at 23 (¶ 51). If that proposal is adopted, a subsequent licensee who benefits from a paired link relocation will be obligated to pay in full for that portion of the initial licensee's expenditure from which the subsequent licensee benefited, rather than paying a lesser, depreciated amount. See id.

[136] See Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8831 (¶ 7). In the case of 2 GHz MSS, the "$T_m$" factor should be excluded from the cost-sharing formula because there is only one service area. This treatment would be the same as where the PCS provider relocates a link wholly outside its service area and/or spectrum block — such reimbursement was not "depreciated" under the cost-sharing plan. See id. app. A at 8885 (¶ 17).

[137] See id. app. A at 8896-98 (¶ 43).

adopt such a procedure, even the Commission's cost-sharing formula as modified above would work a tremendous hardship on early entrant 2 GHz MSS licensees and likely lead to significant delays in the inauguration of service as the initial licensees struggle to find ways either to postpone the obligation or await other entrants that would share the burden.[138] In such circumstances, at a minimum, the early entrants would be entitled to reimbursement for their *full* relocation expenses as *new MSS operators were licensed*, rather than being forced to wait for the issuance of a PCN at the time a subsequent entrant's system became operational — which, in the case of satellite systems, would be years later.

In addition, if the Commission adopts a simultaneous, nationwide cut-over for BAS incumbents, the IUSG urges the Commission to require that all 2 GHz MSS licensees deposit with the clearinghouse or a designated financial institution the sum of $5 million within 60 days of the issuance of their respective licenses.[139] These funds, to be held in an interest-bearing escrow account until reimbursement obligations are determined in accordance with the aforementioned procedures, would be used as necessary to defray the unnecessarily large expenditures forced upon the early entrant systems by the nationwide simultaneous cut-over.[140]

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138 The Commission itself recognized the likelihood of such actions, and was aware that they would not serve the public interest in the early introduction of service. See id. at 8831 (¶ 7).

139 Only those licensed systems meeting appropriate construction milestones, however, should be permitted to participate in relocation negotiations.

140 If the $5 million deposit were not sufficient to cover the subsequently entering MSS licensee's share of relocation costs, the deposit of additional funds would be required upon determination by the clearinghouse of this obligation. If the deposit (continued...)

Such a deposit requirement would not obligate subsequently licensed systems to pay any more for necessary relocations than they otherwise would; rather, the subsequently licensed systems would merely be required to pay their allocable shares earlier, and at a time when such payments would help ensure that entry of competitive 2 GHz MSS would not be not unduly delayed because of the relocation cost process.[141] Otherwise, a tremendous disincentive would be created to being the first 2 GHz MSS licensee to market that would clearly contravene the public interest.

The IUSG recognizes that the Commission may be hesitant to revisit procedures and concepts that it established for other services after extensive comment and evaluation. As the Commission itself has recognized numerous times, however, different services require different regulatory treatment.[142] The IUSG urges the Commission to revisit its relocation cost process and cost-sharing formula for PCS with the unique attributes and circumstances of 2 GHz MSS in

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[140](...continued)
were to exceed the amount owed for relocation by the new entrant, the excess would be refunded (along with any interest accrued on the deposit).

[141] The IUSG agrees with the notions embodied in paragraph 77 of the Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8864, that, inter alia, alternative cost-sharing arrangements between MSS licensees should be permitted in lieu of participation in the cost-sharing plan.

[142] See Implementation of Section 3(n) and 332 of the Communications Act, *Second Report and Order*, 9 FCC Rcd 1411, 1474-75 (¶ 162) (1994) (". . . recogniz[ing] that differential regulatory treatment of different classes of [Commercial Mobile Radio Services] providers may become warranted because of rapidly changing circumstances in the CMRS marketplace"). See also Telecommunications Services Inside Wiring, *Report and Order and Second Further Notice of Proposed Rule Making*, 13 FCC Rcd 3659, 3662 (¶ 2) (1998) (maintaining different sets of rules for the telephone and cable demarcation points as these services will be delivered differently in the near future).

mind, and to adopt the changes recommended above. It is essential that the Commission not adopt policies which discourage competition merely for the sake of procedural consistency.

### D. MSS Licensees Capable of Sharing with Incumbents Should Not Be Required to Pay for or Share the Cost of Subsequent Relocations Required by the Entry of New MSS Licensees.

While all 2 GHz MSS licensees should be required to pay their allocable share of relocation costs caused by their operations in the band, it would be punitive and spectrum-inefficient to require an MSS licensee that is capable of sharing spectrum with 2 GHz incumbent licensees — and, therefore, has no need to relocate the incumbents' facilities — to pay for the cost of any prior or subsequent relocations made necessary by the earlier or later entry of an additional MSS licensee into the band used by the initial entrant.

This concept is in keeping with the Commission's policy, articulated in the context of MSS/FS relocation issues and discussed above, that an MSS licensee will not be required to pay to relocate an incumbent licensee with which it can share spectrum.[143] Indeed, the Commission itself acknowledges the possible benefits of such an approach in seeking comment on whether systems capable of sharing "should be exempted from participation in the relocation/retuning of BAS."[144] The IUSG believes they should.

The fundamental premise underlying the entire incumbent relocation program is that only those facilities subject to harmful interference from new emerging technology providers need be

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143 See MO&O, FCC 98-309, slip op. at 13-14 (¶¶ 27-28).

144 Third NPRM, FCC 98-309, slip op. at 19 (¶ 42).

relocated.[145] If an MSS entrant does not cause such harmful interference, it has no relocation obligation. There is no economic or policy justification — and the Commission has offered none — for requiring an MSS entrant that is capable of sharing spectrum to pay for relocation merely because an earlier or later entrant cannot use spectrum as efficiently, or otherwise causes harmful interference to incumbent licensees.[146]

### E. MSS Licensees Should Not Have to Pay for the Relocation of Primary FS Incumbent Operations With Which They Could Have Shared Spectrum.

Similarly, and also in keeping with the Commission's holding that MSS licensees need only relocate the operations of those primary FS incumbents that receive harmful interference from MSS operations,[147] the IUSG urges the Commission to affirm that an MSS licensee will not be required to reimburse any other licensee for the cost of relocating primary FS incumbent operations with which the MSS licensee could have shared spectrum. Thus, although the Commission proposes to require that an MSS licensee that commences service in spectrum in the 2165-2200 MHz paired band reimburse a new licensee that has previously relocated an FS link pair from that band and the 2115-2150 MHz band for half of the new licensee's relocation

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145 See, e.g., MO&O, FCC 98-309, slip op. at 13 (¶ 27); Microwave Relocation/Cost-Sharing First R&O and FNPRM, 11 FCC Rcd at 8845 (¶ 37).

146 A possible exception to the approach recommended by the IUSG on this subject may be warranted where neither system causes harmful interference to incumbent licensees if operated alone, but where either will do so if both systems operate together. In such cases, the Commission's should consider whether requiring the earlier entrant to reimburse the later entrant may be justified under certain limited circumstances.

147 See MO&O, FCC 98-309, slip op. at 13 (¶ 27).

expenditures,[148] the Commission should not require such reimbursement of an MSS licensee that could have shared the relevant portion of the 2165-2200 MHz band with the relocated FS operations. Clearly, MSS licensees cannot reasonably be required to pay for any part of the relocation by other parties of primary FS operations which they would not have been required to relocate themselves.

## VI. CONCLUSION

This proceeding provides the Commission with a significant opportunity to promote the rapid entry of new — and widely anticipated — competition in the U.S. MSS marketplace. Rapid entry, however, requires Commission adoption of incumbent transition policies that recognize the unique needs of 2 GHz MSS. While the recommendations set forth herein satisfy these needs, they also strike a fair balance between the needs of MSS and those of incumbent licensees by minimizing the logistical and financial burdens of all parties concerned. Unless the Commission is willing to adopt the proposal previously submitted by the IUSG and ICO ex parte, the IUSG urges the Commission to adopt rules providing for the transition of 2 GHz incumbents consistent with the recommendations in these comments.

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[148] See Third NPRM, FCC 98-309, slip op. at 23 (¶ 51).

Respectfully submitted,

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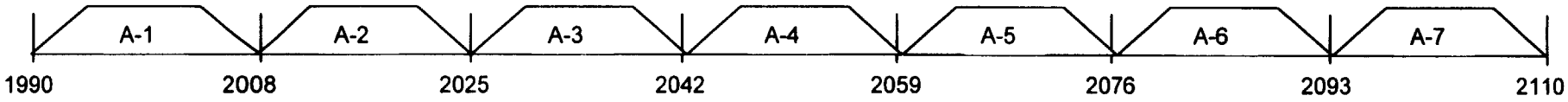
February 3, 1999

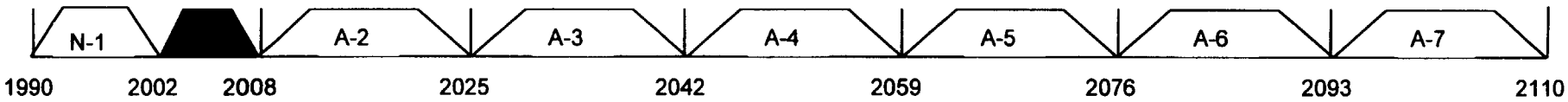
# EXHIBIT 1

# IUSG Suggested BAS Transition Plan

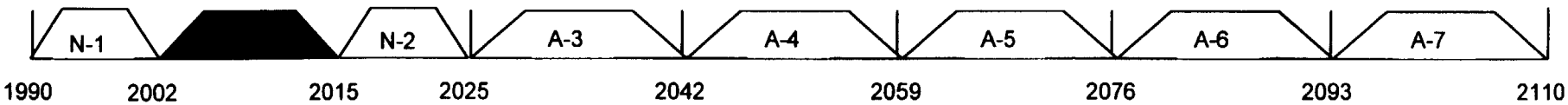
Current BAS channellization (note: A-x refers to existing analog channels; N-x refer to new 12MHz analog or 10MHz digital channels)



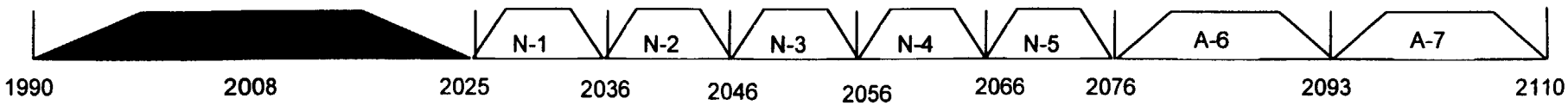

Step 1: Minimum impact to broadcasters: conversion to digital or narrow band FM analog in 12 MHz channel frees up 6 MHz for MSS




Step 2: Converts one more BAS channel to 10MHz digital for an additional 7MHz for MSS (total=12MHz) – needed only after 200x




Step 3: Clears all of MSS spectrum, leaves legacy wideband analog channels for broadcasters (important to allow continued use of portables, etc. that may not be easily converted to digital and to allow roaming of analog trucks from stations that did not have to convert earlier.



# EXHIBIT 2

CALIFORNIA MICROWAVE MICROWAVE RADIO COMMUNICATIONS

# APPLICATION NOTE TwinStream™

## APPROACHES TO PLANNING AND DEPLOYING MRC'S INNOVATIVE DUAL (ANALOG AND DIGITAL) CARRIER MICROWAVE SYSTEM

*Prepared by:*
*Microwave Radio Communications*

As television broadcasters deploy the infrastructure for their new digital television (DTV) channels, a pressing issue is the availability of RF channels to support the studio-to-transmitter link (STL). One approach that early adopters have used is to compress the analog component signal using MPEG-2 techniques, and then multiplex that datastream (typically 15 to 20 Mbps) with the ATSC (Advanced Television Standards Committee) transport stream (at 19.39 Mbps). The combined transport stream is readily accommodated within a 44.736 Mbps DS3 microwave link. MRC offers the DAR45 microwave radio system and the QM4 modems to upgrade FLH-DAR analog radios for these applications.

Another approach is to use previously underutilized spectrum for either the ATSC or the NTSC STL, such as the 17.7-19.7 GHz band. MRC offers the DMR-18 Digital or Analog Microwave Radio for these applications, as well as the DAR20 microwave radio, which provides a dedicated 19.39 Mbps (plus "wayside" DS1 channel).

Each of these approaches are valid, but the compressed NTSC approaches entail increased system cost, complexity, and latency (video and audio processing delays). The additional RF channels approach is straightforward, but less conserving of RF spectrum.

To answer these concerns, Microwave Radio Communications has developed an innovative dual carrier radio system, the TwinStream™ Analog and Digital Microwave Radio System. Through a thorough system design using the latest filtering, frequency conversion, microwave sources, and modulation approaches, MRC has created a radio system that can be deployed within existing 25 MHz channels (at 6.8-7.1 or 12.7-13.2 GHz) and carry both the NTSC and the ATSC programming in their native transport stream formats (composite analog for the NTSC, 19.39 Mbps for the ATSC). In addition, the 19.39 Mbps modem also incorporates a DS1 (1.544 Mbps) data channel that can be used for highly compressed video, an aural STL, LAN traffic, or multiple voice channels.

Unlike some possible "add-on" approaches that assume that existing analog STLs can be retuned lower in the same channel band, tightly filtered, and then have a digital radio combined at RF in the waveguide, the MRC TwinStream solution is completely engineered. With the TwinStream, both RF chains (analog and digital) with their modulators or demodulators are completely enclosed within one three-rack unit high transmitter or receiver.

## TWO CHANNELS THROUGH THE TWINSTREAM TRANSMITTER

As a total system design, the TwinStream incorporates both the analog (NTSC) and digital (ATSC) RF paths in a single RF shelf. The transmitter can be equipped with both analog and digital modulators or accept a direct IF connection from a separate modulator or as a drop and insert if used as a multi-hop configuration.

In MRC's patent-pending "Gemini IF" design (see *Figure 1*), the intermediate frequency signals from the analog and digital modulators are offset in frequency, and then mixed with separate local oscillators to create the specified output frequency. Each signal is then amplified and passed to the RF combiner, where the two channels are mixed and then fed to a single waveguide connection to the transmit antenna. Unlike add-on techniques, the TwinStream requires normal waveguide connections and a single polarity antenna.

## RECEIVING TWINSTREAM SIGNAL

With the TwinStream receiver, both the analog (NTSC) and digital (ATSC) circuitry are contained within a single radio shelf. The receiver can be equipped with both analog and digital demodulators or accept a direct IF connection from a separate demodulator if used as a drop and insert in a multi-hop configuration.

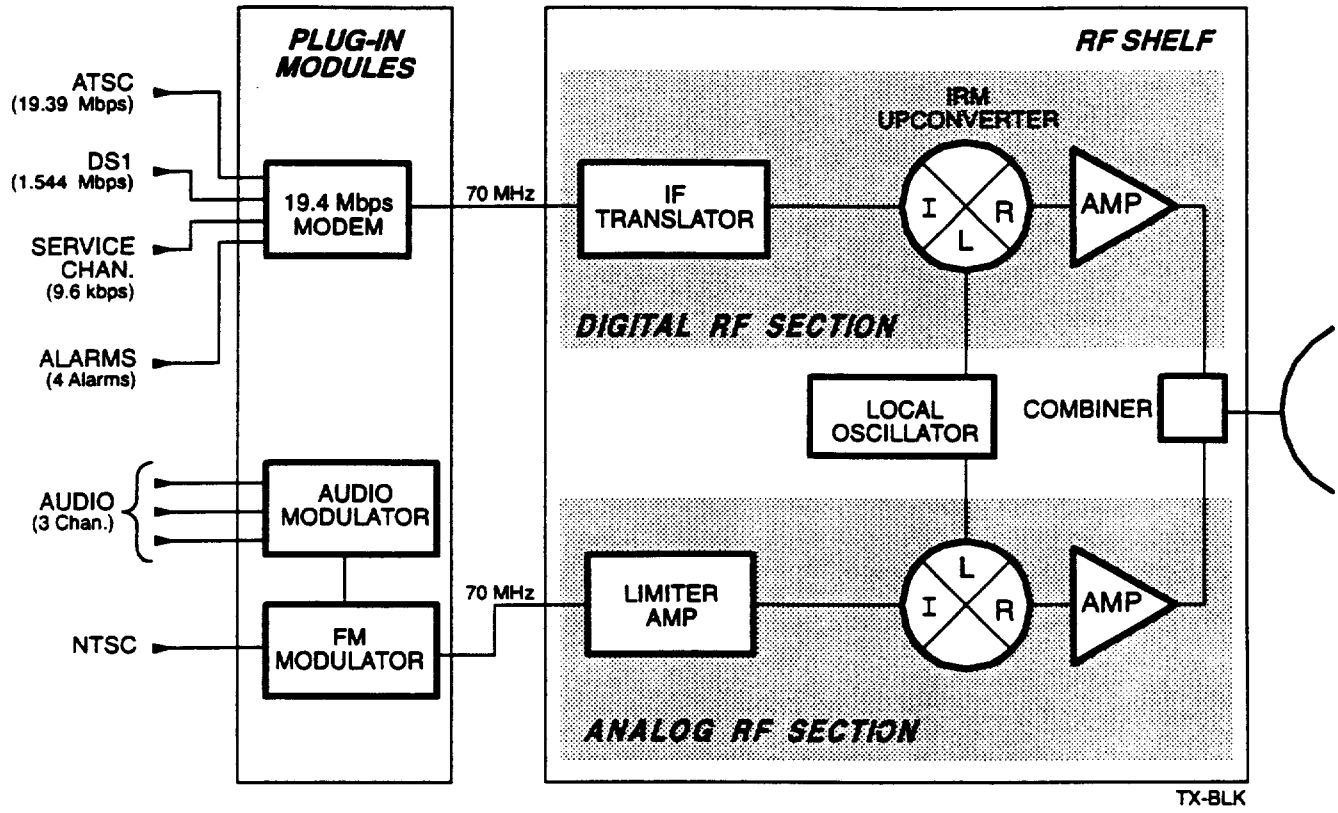



*Figure 1: MRC's Patent-Pending Approach to a Dual-Carrier Transmitter*

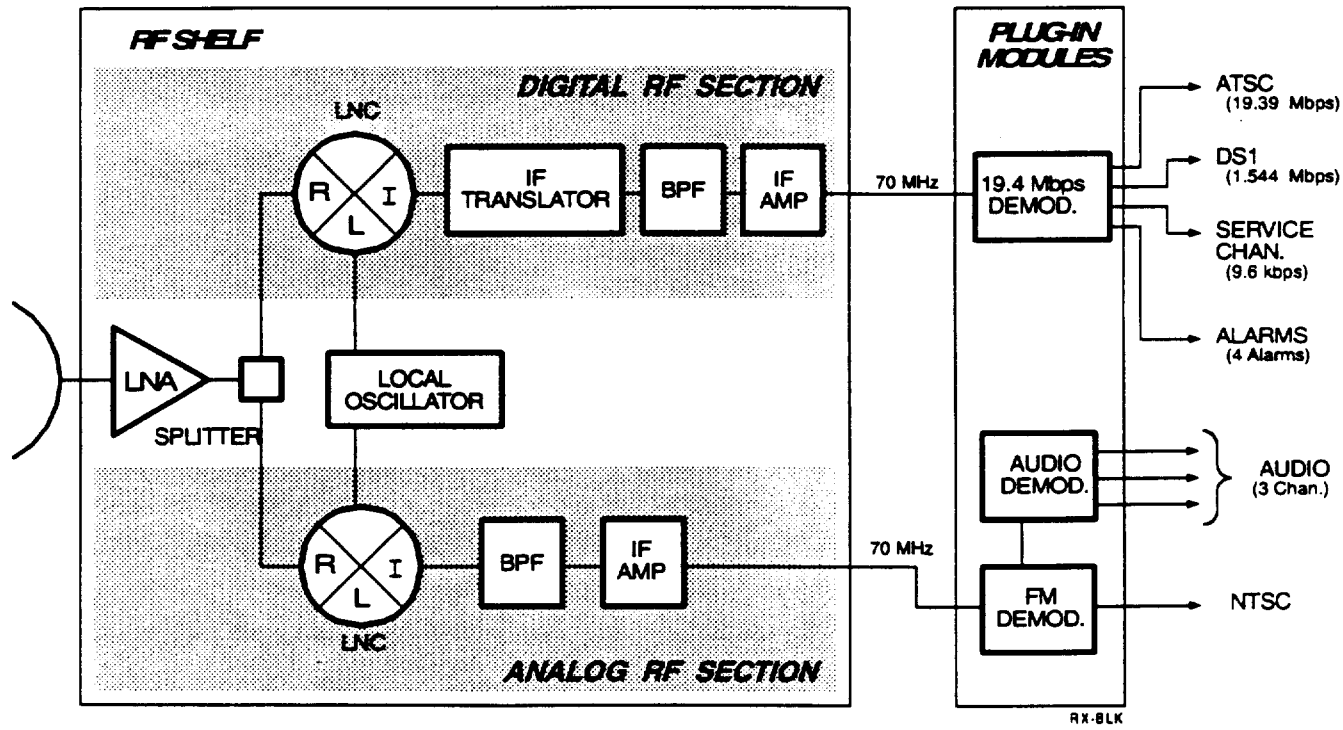



*Figure 2: MRC's Patent-Pending Approach to a Dual-Carrier Receiver*

From the receive antenna (see *Figure 2*), the two channel RF signal is routed to the radio through waveguide, and then enters the LNA. It is routed to a signal splitter creating two identical signals, which are fed to two separate LNCs. The LNCs are the entry point for both the analog and digital RF chains. The output of each LNC is then mixed with a local oscillator to create two intermediate frequency signals. The digital IF, which had been offset in the transmitter from the analog IF, is then converted to a normal IF of 70 MHz before feeding the digital modulator. Both the analog and digital IF channels are filtered and amplified prior to being demodulated by separate analog and digital demodulators.

Each of these modems then output a standard transport stream: analog NTSC and 19.39 Mbps ATSC, for feeding the analog and digital broadcast transmitters. In addition, the digital demodulator outputs a 1.544 Mbps (DS1) channel that can feed a radio transmitter or provide other voice or data traffic to the transmitter site.

## ELEGANT PROTECTION & DIVERSITY RECEIVE SWITCHING SYSTEMS

The integrated, dual-carrier design of the TwinStream radio makes it easy to incorporate hot-standby and diversity receive switching systems. The addition of the MRC hot-standby switching shelf to a pair of TwinStream transmitters, and a mating switching shelf to a pair of TwinStream receivers, completes the hot-standby protection design: A complete, protected dual-carrier system in just nine rack units per end.

For diversity receive applications, just two receivers and a one-rack unit diversity switch unit provide a complete diversity receive terminal in seven rack units.

## SYSTEM GAIN CONSIDERATIONS IN DEVELOPING SYSTEM LINK BUDGET

Planning for any new microwave system installation includes developing the system link budget for the microwave path. When the TwinStream radio is replacing an existing analog microwave system, it is important to analyze each element of the RF chain, including waveguide and antennas. It is also important to model the digital signal to ensure that the 19.39 Mbps ATSC transport stream will have sufficient system gain.

Compared to the analog part of the radio link, the ATSC transport stream is modulated by 16-level quadrature amplitude modulation (16QAM) techniques, requiring a more linear signal than the analog channel. With the reduced power output created by linearizing the power amplifier, and the reduced receiver sensitivity of a digital design, the TwinStream (consistent with any digital radio design) offers approximately 8 dB less system gain than the analog channel. Typical approaches to overcoming this reduced system gain include increasing antenna sizes, upgrading antenna and waveguides to minimize VSWR losses, and adding a diversity receive system.

## USING THE TWINSTREAM FOR SATELLITE AND ENG BACKHAULS

As television stations start their transition to digital broadcasting, the studio-to-transmitter link is just one area where the innovative dual-carrier TwinStream radio makes sense. Where the network programming satellite receive site is not co-located with the TV studio, it may be necessary to combine both NTSC and ATSC programming feeds on the same TSL or backhaul link. There are three different scenarios in which the TwinStream can be used for this requirement:

1. Configure the TwinStream identically as for the STL, that is, with the analog NTSC carrier and a 19.39 Mbps ATSC carrier. This scenario, of course, would require either network transport of the 19.39 ATSC transport stream, or placement of an ATSC encoder at the transmitter site to reduce a higher bit rate network program stream to the 19.39 Mbps transport stream rate.
2. Convert the "analog" carrier of the TwinStream to a 45 Mbps (DS3) digital carrier by the addition of the QM4 16QAM modulator and demodulator, with corresponding linearization of the 45 Mbps carrier RF channel. In this scenario, the network program feed of the ATSC programming at DS3 rates would be transmitted through the broader, 45 Mbps RF channel. The analog NTSC programming would be encoded and compressed, using a product such as the MRC MediaMux™ MPEG-2 encoder, and placed on the narrower 20 Mbps RF channel.
3. Order the special "Analog + DS3" version of the TwinStream, which features a full 44.736 Mbps datastream on the narrower digital RF channel, rather than the 19.39 Mbps datastream. In this configuration, a higher order modulation rate (128QAM) is used, at a reduced system gain. For this reason, great care must be used in profiling the digital link performance for this option.

The TwinStream is an ideal "evolutionary" approach to digital electronic newsgathering as well. Due to pending changes in the 2 GHz broadcast auxiliary band, broadcasters are anticipating converting to digital modulation techniques as a way to accommodate

narrower RF channels. During a transition phase from analog to digital ENG, it may be desirable to have both analog and digital newsgathering taking place simultaneously. The TwinStream, then, is the ideal way to backhaul analog and digital ENG signals from a remote central receive site.

Other potential applications for the TwinStream include feeding both ATSC and NTSC programming channels to cable headends, translators, and to TV studios or transmitters in an adjacent market.

## PLANNING FOR A DIGITAL FUTURE: UPGRADING FROM ANALOG PLUS DIGITAL TO FULLY DIGITAL

The TwinStream is designed to provide reliable service for years to come, which means that a time may come when the analog carrier portion of the radio link is no longer needed. At that point, the TwinStream user will have three major options for adapting the TwinStream to a fully digital environment:

1. Remove the analog radio and use the TwinStream as a 7.5 MHz wide STL for the DTV channel only.
2. Replace the analog modulator and demodulator with digital modems, with some adjustment to the RF signal chain to linearize the power output and eliminate the AM limiter. This second DTV channel can be used as a backup, to feed a second DTV channel, or for other yet unplanned digital transport requirements.
3. Replace the digital modems on both sides of the radio with a wider bandwidth modem, such as the MRC 45 Mbps QM4 modem. This approach could be used to transport a less compressed digital video contribution stream prior to creating the ATSC distribution transport stream of 19.39 Mbps.

As a comprehensive STL solution, the TwinStream offers more than a migration to DTV transport today. The TwinStream provides an evolutionary approach to digital television standards today and in the future.

## WHY TWINSTREAM IS A BETTER APPROACH TO ANALOG PLUS DIGITAL

When the FCC allocated one new DTV channel for each existing NTSC channel, it did not create additional RF spectrum to support microwave STLs. With the TwinStream, the 19.39 Mbps ATSC transport stream, a DS1, and a service channel can be modulated and transported alongside a conventional analog video stream within a standard 25 MHz STL channel. Because the dominant RF component of the TwinStream is the analog carrier, the TwinStream is licensable under standard analog STL procedures for the 6.8-7.1 and 12.7-13.2 GHz broadcast auxiliary bands.

Of course, there are alternatives to the TwinStream:

1. Digitize and compress the analog NTSC programming for multiplexing, through a product such as the MRC MediaMux, with the ATSC transport stream, at increased cost over the TwinStream solution.
2. Retune an existing analog FM radio and add a new 19.39 Mbps interface radio through exacting filtering and waveguide combining, at increased complexity and risk over the TwinStream approach.
3. Lease fiberoptic services for the DTV STL, with increased, recurring operating costs over the TwinStream radio.

Depending upon the implementation strategies and requirements of the individual broadcaster, each of these alternatives to the TwinStream may make sense. For the overwhelming majority of broadcasters, however, the TwinStream offers out-standing value and a low-risk way of adding DTV programming to an existing analog microwave path.

For more information about the TwinStream, and MRC's entire line of digital video transport solutions, please contact your local MRC representative.

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# EXHIBIT 3

Nucomm™

MICROWAVE SOLUTIONS FOR THE DIGITAL AGE

**IMMEDIATE RELEASE**

Hackettstown, N.J. August 13, 1998:

## Nucomm Introduces Dual Stream STL System for HDTV requirements

Today NUCOMM, Inc. announced that it is introducing the "Dual Stream" Microwave Studio to Transmitter link systems which reduces the cost and simplifies the transition to HDTV. These systems are required for the Broadcaster's FCC-mandated November HDTV sign-on requirements.

Nucomm is the first to provide Broadcast digital microwave systems. The Dual Stream system is the first dual carrier microwave system for transmission of uncompressed analog NTSC plus the HDTV ATSC signals in a 25 MHz microwave channel. The system uses a preparatory technology to combine the analog and digital signals by shifting the IF frequency for each signal.

This new technology was developed to overcome several obstacles Broadcasters are facing during their transition to HDTV. First there is a shortage of microwave channels in the various cities around the United States, second the analog NTSC signal will be short lived. Thus the broadcaster can save on expensive "Compression" equipment, third this system will eliminate the latency issues concerning ENG IFB/monitoring issues.

In addition to STL requirements, the Dual Stream system is ideal for Transmitter to Studio links, Satellite backhaul, Cable "Head End" feeds and ENG applications.

Nucomm has been and continues to work with several of the major networks and broadcast groups in developing HDTV digital microwave systems. This new system and it's preparatory technology along with other HDTV digital systems were first developed by Nucomm. This is the latest in a long line of industry first offered by Nucomm, Thus maintaining its strong leadership role.

Orders are being accepted and will be available in November of 1998. Standard deliveries will be 45 to 60 days thereafter.

Nucomm, Inc is a world wide provider of video Microwave transmission equipment for the Television Broadcast Market. In addition, Nucomm provides video microwave transmission equipment for

Military, Law Enforcement, Telcecom and Cable Television industries. Nucomm designs, manufactures and markets it's product from their Hackettstown, NJ factory. Nucomm is the technology leader for video microwave products. You can contact Nucomm by phone 908-852-3700 or visit their Web site www.nucomm.com.

101 Bilby Road, Hackettstown, N.J. 07840 Phone: 908-852-3700
FAX: 908-813-0399 www.nucomm.com


**IMMEDIATE RELEASE**
**CBS CORPORATION AND NUCOMM ON THE FOREFRONT OF HDTV TECHNOLOGY**

Hackettstown, NJ August 28, 1998:

Today NUCOMM, Inc. is proud to announce that it has been selected by CBS Corporation for the manufacture, test and commissioning of its Dual Channel Digital Microwave Links (STL) to be installed at three CBS Owned stations. The system plays a vital role in delivering HDTV signals to the viewing audience which is planned this fall.

NUCOMM was chosen based on the advanced products being offered and their engineering expertise in the area of digital microwave transmission through extensive field-testing.

Each Digital Microwave link will combine the stations NTSC analog signal and the new High Definition TV (HDTV) signal at the Studio and transport them via microwave to the TV Stations NTSC and HDTV Transmitters (the transmitters are located at a remote site from the studio). This system, conceived and designed by NUCOMM, is unique in that it is the first commercial microwave system installed in the United States that will link the TV Studio to the NTSC and HDTV Transmitter through a single microwave channel. This represents yet another step in the deployment of HDTV.

The stations to receive the NUCOMM equipment are WCBS-TV in New York City, KYW-TV in Philadelphia and KPIX-TV in San Francisco.

Each STL link will consist of NTSC encoders to digitize and compress the analog NTSC signal to 15Mbps. The 19.39 Mbps HDTV signal and the 15 Mbps NTSC signal will be multiplexed together in a NUCOMM designed DIGI-MUX multiplexer. The DIGI-MUX multiplexer has the unique characteristic in that it can output a transport data stream at the combined data rate of up to DS3 (44.736 Mbs) for transmission over microwave links or over a Telco, Fiber Optic Cable or Satellite system.

101 Bilby Road, Hackettstown, N.J. 07840 Phone: 908-852-3700
FAX: 908-813-0399 www.nucomm.com

2-2-2-2-2

CBS CORPORATION AND NUCOMM

NUCOMM will utilize it's own versatile field programmable, DIGI-QAM Digital Modulator that can transmit the combined transport stream at variable rates from 15 Mbps

to over 45 Mbps (DS3). The modulation type is PC selectable between QPSK, 8PSK or 16QAM depending on the data rate and allowable microwave channel bandwidth.

The entire system including the dual microwave transmitters and receivers will be operated in a Hot-Standby configuration to provide full redundancy of both the NTSC analog and HDTV signals.

At the transmit point (studio), the system combines the NTSC analog signal (digitized by the encoder) and HDTV signals through the Nucomm DIGI-MUX multiplexer which feeds a Nucomm 70DMT7 Modulator. The combined data rate of 35 mbps is modulated at 70 MHz and fed to Nucomm's Digalog Transmitter. At this point, the 70 MHz signal is upconverted to a 7 or 13 GHz frequency and transmitted.

At the remote transmitter site, the 7 or 13 GHz signal is received and downconverted to 70 MHz. The 70 MHz signal is fed to Nucomm's 70DMR7 Demodulator where by the original 35 mbps data stream is recovered and fed to the DIGI-MUX de-multiplexer. The output of the DIGI-MUX provides an HDTV and encoded analog NTSC signal. The HDTV signal is converted to the SMPTE-310 format by NUCOMM's GA-Link and fed to the HDTV Transmitter. At KYW-TV the HD Transmitter is 700 feet from the De-multiplexer. A GA Link using DVB-ASI coding over a fiber will be used. The NTSC signal is decoded back to its' original analog NTSC signal and fed to the NTSC Transmitter.

NUCOMM, Inc is a worldwide provider of video Microwave transmission equipment for the Television Broadcast Market. In addition, NUCOMM provides video microwave transmission equipment for Military, Law Enforcement, Telecomm and Cable Television industries. NUCOMM designs manufactures and markets its products from their Hackettstown, NJ factory. NUCOMM is the technology leader for video microwave products. You can contact NUCOMM by phone 908-852-3700 or visit their Web site www.nucomm.com.

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